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Nozzle for supporting a weft thread in a weaving machine.

The present invention concerns a nozzle for supporting a weft thread in a weaving machine, in other words a nozzle for creating a fluid jet to carry a weft thread along the reed of the weaving machine through the weaving shed.

In the first place is meant a relay nozzle for an air jet weaving machine by such a nozzle, but it is clear that more generally also other nozzles are meant by it, also for other fluids than air.

It is known that such nozzles can be made in different shapes, as a function of the aimed effect.

Thus, for example, a nozzle is known from BE 1,012,608 which is provided with a lateral protuberance near its free end which is mainly directed towards the reed when the nozzle is used. This special outer shape offers the advantage that the nozzle can be smoothly moved through the warp threads in and out of the weaving shed. Such a special outer shape has for a result that, if the nozzle were made of a housing with a constant wall thickness, also the inner shape would assume the special design of the outer shape, which of course is not ideal for the flow of the fluid through the nozzle. That is why it was suggested in BE 1,012,608 to apply an inner shape which differs from the outer shape.

Also from other patent documents, for example EP 0,145,824, CS 266,516 and CS 281,607 it is known to apply an inner shape which clearly differs from the outer shape.

A general problem with the techniques known until now for manufacturing nozzles consists in that it is not easy to provide a desired flow-through canalisation therein, especially not when the inner shape of the nozzle differs from the outer shape.

In general, such nozzles are relatively small, and providing a flow-through canalisation therein was not simple until now, all the more as such a flow-through canalisation has to be made rather accurately, as it determines the flow of the fluid leaving the nozzle, in other words of the outgoing fluid jet, and as such a fluid jet has to be directed as powerful and as good as possible in order to optimally move a weft thread along the reed.

Also, according to a first aspect of the invention, it aims a nozzle which can be made in an efficient manner, whereby the inner shape and the outer shape can be easily optimised independently from each other and whereby practically any shape whatsoever can be easily realised.

According to this first aspect, the invention concerns a nozzle for supporting a weft thread in a weaving machine which is provided with a flow-through canalisation for a fluid flowing out in at least one outlet opening, characterised in that the nozzle is at least partially composed of segments.

By making use of segments, they can be easily made separately and be joined together afterwards. Since every segment only forms a part of the whole, it is as such easily accessible from all sides and there is no problem to realise it in any desired shape whatsoever.

Further, the use of such segments makes it possible to easily realise different inner shapes, in other words shapes for the flow-through canalisation.

The segments are preferably made plate-shaped, in particular as thin plates which are placed against one another. In order to form such plates, one can simply take a base plate out of which said plates can be made in any desired shape whatsoever. It is clear that in order to make them, a large number of techniques known as such are available, such as for example wire sparking, laser cutting, milling, etching, electroforming, fine-blanking, etc. Techniques of another nature are not excluded either. Thus, for example, the plates can also be realised by means of a casting technique, after which they can possibly be finished mechanically.

The segments may be formed of straight, flat elements, for example flat plates, which are placed against each other. Such straight, flat elements offer the advantage that they can be easily realised and are also easy to combine into a whole. However, this does not exclude that segments can also be applied having a shape which is different from a flat shape, which offers the advantage that it is easy to

create special effects, for example in view of the optimisation of the fluid jet flowing out of the nozzle.

The segments, in particular the plates, can be made with a constant thickness as well as with a varying thickness, which also allows to create different effects. It should be noted that the thickness of the segments can be very small and may for example amount to 0.1 mm or even less. Further, it is possible to apply segments of varying thickness and/or shape in one and the same nozzle, so that for example partition walls realised with the latter can be made very thin, whereas the segments serving as lateral parts can be made relatively thick.

The use of segments offers the advantage that any shape whatsoever can be easily made with great accuracy.

According to a preferred embodiment, the segments are held in a casing, as a result of which they remain together with certainty. Moreover, the casing can be made of a thin plate material, such that a smooth outer side is at all times guaranteed, which is important in order to prevent the warp threads from meshing in the nozzles. It is clear, however, that such a casing is optional, since, according to a variant, it is possible to provide the segments as a whole with a smooth outer side.

The different segments, in particular the different plates, can be mutually connected, either in a mechanical manner or in any other way whatsoever, for example by means of gluing, welding, sintering, etc. An advantageous technique

for welding plates together consists in that use is made of hard soldering in a vacuum or in a specific gaseous atmosphere in an oven. The solder can hereby be provided on the plates by means of for example a silkscreen printing technique, which allows for a very precise dosage of the jointing media.

It should be noted that for example the etching and fine-blanking of plates, as well as vacuum soldering in an oven can be done very cheaply in large quantities, guaranteeing an economic production.

According to another possibility, at least a number of the segments can be pressed loosely against one another. In the case where the segments are for example pushed in a casing, this casing can make sure that the segments are automatically held together.

The segments can be made of any material whatsoever offering sufficient stability. Practical examples are for example metal, such as steel or aluminium, and ceramic material. Also the use of less costly materials, such as for example synthetic material, is not excluded.

Although the segments can be made in different shapes and dimensions, use is preferably made of a series of segments extending in the longitudinal direction of the nozzle, for example a series of plates placed against each other.

In the case of plate-shaped segments, they are moreover preferably situated in planes extending mainly crosswise to

the front side of the nozzle, in other words which are situated such that they are directed with one edge to the side of the nozzle in which the outlet opening or outlet openings are situated.

The segmented construction according to the invention makes it possible for the nozzle to be provided with internal partition walls of different nature in a relatively simple manner, especially when plate-shaped segments provided next to each other are used. According to a special embodiment, such a nozzle will have one or several parts built up by means of the segments serving as a partition wall in the flow-through canalisation.

Such partition walls are in the first place designed to optimise the fluid flow, but they can also be used for other effects, such as for example to reinforce the structure of the nozzle or the like.

The partition walls can be made in different manners, offering different advantages, which will become clear from the following description of the examples represented in the figures.

According to a second aspect of the present invention, it concerns a nozzle which is provided with at least two outlet openings, whereby at least one either or not partition wall of one piece is present in the top part of the nozzle separating at least the two outlet openings, at least as of a point situated inside the actual flow-through canalisation up to the outer wall, or practically up to the

outer wall where the outlet openings open in the outer side. Thus is obtained that the fluid is guided not only at the height of the outlet openings, as is known from BE 1,012,608 and JP 55-172384, but that the fluid is also efficiently guided inside the actual head part of the nozzle, as a result of which it may be assumed that it is possible to obtain better flow characteristics for the fluid. Thanks to a correct positioning of such a partition wall, or possibly of several of such partition walls in the flow-through canalisation, it also becomes possible to supply the fluid in the right proportions to each of the outlet openings.

Thanks to this second aspect is also obtained that the fluid is guided separately up to the moment when the fluid leaves the nozzle, which is particularly useful to optimize the outgoing fluid jet, as opposed to the embodiment described in EP 0,145,824, where there is no partition in the actual outlet opening.

According to a third aspect of the present invention, it concerns a nozzle which is provided with one or several partition walls extending in the longitudinal direction of the flow-through canalisation, whereby these partition walls extend crosswise and continue materially from one side of the flow-through canalisation up to the opposite other side. By making use of one or several partition walls extending as a single material through the flow-through canalisation, this offers the advantage that the structure of the nozzle is reinforced. Compared to a partition wall which is free at one far end opposite to the opposite side,

as is known from EP 0,145,824, this moreover offers the advantage that any meshing of pieces of fluff or little hairs of warp threads and/or weft threads as they get jammed in between the free end of the partition wall and the opposite wall, which may result in obstructions, is excluded.

According to a fourth aspect of the present invention, it concerns a nozzle which is provided with at least one partition wall made as a cross partition in the shape of a blade-shaped guide near the outlet opening or outlet openings. The use of actual blades offers the advantage that an individual direction for the outgoing fluid can be realised for each individual outflow duct.

According to a fifth aspect of the present invention, it concerns a nozzle which is provided with one or several partition walls, whereby at least a number thereof extend downward up to at least a distance from the outlet opening or outlet openings, which is larger than the hair length of the hairs which are usually found on textile fibres, in particular up to a distance of about 1 cm. Thus, fibres, hairs and the like which have penetrated cannot mesh behind the inner edge of such partition walls, which may be the case with traditional embodiments.

According to a sixth aspect of the present invention, it concerns a nozzle which is provided with at least an intermediate connection extending through the flow-through canalisation and forming a reinforcement for the body of the nozzle, which intermediate connection may for example

also consist of a partition wall. Thus, the bending strength of the nozzle is considerably increased, as a result of which the risk of deformations which may have an influence on the direction of the fluid jet is reduced. By the body is hereby meant the slender top part which, as is known, is at least partially moved through the warp threads. Said intermediate connection preferably extends at least through the central part of the body and, better still, it extends over a large part of the aforesaid body up to, or practically up to its bottom side.

According to a seventh aspect of the present invention, it concerns a nozzle which is provided with a series of outlet openings which are arranged in a step-like manner from one far end of said series to the other far end in relation to the longitudinal direction. Thus, in a general manner, it is possible to realise a relatively flat fluid jet. Thanks to the correct position of the stepped arrangement, it moreover becomes possible for the fluid jet to optimally work in conjunction with a weft thread which is usually situated in the conveyor duct in the reed.

According to an eight aspect of the present invention, it concerns a nozzle which is provided with a head part, whereby one or several partition walls are present in the flow-through canalisation of this head part which, as a result of their direction and/or shape, function as guiding elements to direct the fluid jet or fluid jets leaving the outlet opening or outlet openings when the nozzle is used. Thus, it is not only the outermost inner wall of the flow canalisation which determines the direction and the

behaviour of the outgoing fluid jet, but this direction is also determined by the partition wall or partition walls. As a result, the behaviour of the general fluid jet can be further optimised, and it is even possible to separately influence the respective partial jets, in other words the jets coming out of the respective outlet openings.

It is clear that the embodiments according to the second to eight aspect are easy to realise in practice by making use of a segmented construction corresponding to the aforesaid first aspect of the invention. However, this does not exclude that nozzles according to the second to eighth aspect of the invention can also be realised without a segmented construction being applied thereby. It is clear that in this case also, the aforesaid advantages remain applicable.

According to the invention, the characteristics of each of the aforesaid eight aspects can be combined at random. Also all other partial characteristics which will appear from the further description and claims can be combined at random with one or several of the main characteristics of each of the aforesaid aspects, at least in so far that these characteristics are not conflicting.

In order to better explain the characteristics of the invention, the following preferred embodiments according to the invention are described as an example only without being limitative in any way, with reference to the accompanying drawings, in which:

figure 1 represents a part of a weaving machine with several nozzles according to the invention;
figure 2 represents a section according to line II-II in figure 1;
figure 3 represents the nozzle represented in figure 2 in perspective and to a larger scale;
figure 4 represents a section according to line IV-IV in figure 3;
figure 5 represents the nozzle from figure 3 when disassembled;
figures 6 and 7 represent views analogous to those of figures 3 and 4, but for a variant;
figure 8 represents another variant as disassembled;
figure 9 represents a section according to line IX-IX in figure 8, but as composed, however;
figures 10, 11 and 12 represent views analogous to those of figures 3, 4 and 5, but for a variant;
figures 13, 14 and 15 represent views analogous to those of figures 3, 4 and 5, but for another variant;
figures 16 and 17 represent sections of two more embodiments of a nozzle according to the invention;
figures 18, 19 and 20 represent cross sections of three further embodiments of a nozzle according to the invention;
figure 21 represents a section of an embodiment, whereby a crosswise directed partition wall is provided in the flow-through canalisation;
figure 22 represents a possibility for realising a nozzle according to figure 21 when disassembled;
figure 23 represents a special embodiment of a nozzle according to the invention;

figure 24 represents a view according to arrow F24 in figure 23;
figure 25 represents a view according to arrow F25 in figure 23 to a larger scale;
figure 26 represents the top end of the nozzle from figures 23 to 25 in perspective;
figure 27 represents a section according to line XXVII-XXVII in figure 25;
figure 28 represents a view analogous to that of figure 2, but for the nozzle from figures 23 to 27;
figures 29 and 30 schematically illustrate an intermediate step of a possible method for realising nozzles according to the invention.

Figures 1 and 2 schematically represent a device 1 for inserting weft threads 2 in a weaving machine, which is provided with nozzles 3, in particular relay nozzles, realised according to the invention.

The given device 1 comprises a slay 4 with a reed 5 fixed to it which is provided with a guide duct 6 along which the weft thread 2 is conveyed. The weft thread 2 is blown into the guide duct 6 by means of a main nozzle 7 and it is further supported by fluid jets, in this case air jets 8 which are generated via the nozzles 3.

As is known, several main nozzles 7-7A can be provided to bring weft threads 2 in the weaving shed as of several weft yarns 9-10.

As represented in figure 2, the nozzles 3 reach with their top ends through the lower warp threads 11 into the shed 13 formed by the lower and top warp threads 11-12 during the insertion of the weft thread 2. The main nozzles 7-7A as well as the nozzles 3 are fed with a fluid under pressure by means of a fluid source 14, for example compressed air, and they are controlled in a known manner by means of valves 15-16 or the like.

As represented in figures 3 to 5, the nozzles 3 are provided with a flow-through canalisation 17 for the fluid, in this case a single duct, which opens into the environment via an outlet opening 18.

The invention is special in that the nozzles 3, at least according to a first aspect of the invention and, as can be seen in figures 3 to 5, are at least partially composed of segments 19-20.

In the given example of figures 3 to 5, the segments 19-20 consist of plates which are provided laterally against each other. These plates extend in the longitudinal direction of the nozzle 3 and they are situated such that they are directed with one edge 21 towards the side 22 of the nozzle 3 in which the outlet opening 18 is situated.

The segments 19 are provided with passages 23 which, when the whole is combined, determine the shape of the flow-through canalisation 17 or, in other words, the inner shape of the nozzle 3.

The segments 20 form end walls which serve as sealing elements or lids.

As explained in the introduction, the segments 19-20 can be fixed against each other in any way whatsoever, for example by means of welded joints 24.

The segments 19-20 can possibly be provided with auxiliary means to mutually position the composing parts, as is schematically represented by means of a dashed line in figure 5, and alternatively, represented connecting elements 25-26 and/or mechanical coupling elements, in particular pins 27 and holes 28. It is clear that a large number of variants are possible.

Figures 6 and 7 represent a variant whereby the segments 19-20 are provided in a casing 29. In this case, the segments 19-20, or at least specific parts thereof, can possibly be pressed loosely against each other, whereby the casing 29 keeps the segments 19-20 together.

In the embodiments of figures 3-5 and 6-7, the passages 23 extend over the entire thickness of the segments 19 concerned. According to a variant which is represented in figures 8 and 9, it is also possible to make use of one or several segments 30, with a passage 31 extending over only a part of the thickness of each segment 30 concerned. Such an embodiment offers the advantage that the wall part 32 remaining next to the passage 31 can serve as a sealing element or partition wall without a separate segment being required to this end. Another advantage consists in that

the material parts 33 and 34 as such remain in a fixed position in relation to each other. Said passage 31 can also be easily formed by means of a mechanical operation, for example by means of milling.

Figures 10 to 12 represent an example of an embodiment of a nozzle 3 according to the invention, whereby the segmented construction is used to realise partition walls 35 in the flow-through canalisation 17 in a simple manner from a constructional point of view. These partition walls 35 consist of parts 36 which are part of segments 37 provided between segments 19, so that these parts 36 also serve as longitudinal partitions.

The parts 36 are limited by a bottom edge 38, such that, when the segments 19-20-37 represented in figure 12 are joined together, a common duct is obtained at the bottom in the nozzle 3, and separate ducts 39-40-41 are created more towards the top, which are situated laterally next to one another in the given example and which extend up to the side 22 and thus define several outlet openings 18.

Thus, it is possible to realise a separate duct towards each outlet opening 18 and/or towards several groups of outlet openings 18, as a result of which a better guiding of the fluid flow is obtained.

In the embodiment of figures 13 to 15 is represented a variant whereby the partition walls 35 are formed by means of segments 47 which are of the same type as the aforesaid

segments 30, whereby the wall parts 32 now function as partition walls 35.

It should be noted that the partition walls 35, in the embodiment from figures 10 to 12 as well as the one from figures 13 to 15, seen crosswise, in particular according to the direction D, extend in one piece from one side to the other side of the flow-through canalisation 17, so that, as opposed to the use of a partition wall which does not continue materially, as is known from EP 0,145,824, no zones are created in which hairs or the like, coming for example from the weft thread 2, can become jammed.

As is schematically represented in figure 16, the partition walls 35, no matter in what way they are formed, preferably extend downward up to a distance A from the outlet openings 18 concerned which is larger than the largest hair length of the hairs 48 which are usually found on textile fibres, in particular on a weft thread 2 or a warp thread 11-12. Thus is excluded that hairs 48 which might penetrate can become entangled under the lower edge 38 and fix themselves there, after they have come off the textile fibre, and become concentrated there. The risk of hairs 48 penetrating as of warp threads is bigger since the outlet openings 18 go through the warp threads 11 at each insertion of a weft thread. Thus, the risk of contamination, in particular of obstruction of the flow-through canalisation 17 is minimised. Practically, the distance A preferably amounts to about 1 cm or more.

Thanks to the segmented construction, it is also easy to realise intermediate connections in the flow-through canalisation 17 which form a reinforcement for the body 49 of the nozzle 3, in other words for the slender part thereof. Figure 17 represents an example thereof, whereby a partition wall 35 is also made as a special reinforcement part. To this end, the partition wall 35 extends over the entire length L of the slender body 49, as a result of which it functions as a reinforcement rib.

In order to obtain such a reinforcement, said partition wall 35 does not necessarily have to extend over the entire length L, but at least one reinforcement will preferably be made in or around the central part 50, so that the body 49 is at least reinforced in the middle.

It should be noted that said reinforcement can possibly be formed of local connecting ribs alone.

The aforesaid segments and possibly partition walls 35 formed thereof can serve as guiding elements, provided they have a suitable direction or shape, to direct the fluid jet 8 leaving the outlet opening or outlet openings 18 when using the nozzle 3. A specific example thereof is represented in figure 18, which shows an embodiment whereby the partition walls 35 consist of plate-shaped elements or the like which extend slantingly at an angle H according to a general direction which, when the nozzle 3 has been mounted in a weaving machine, extends slantingly towards the reed 5.

Figures 19 and 20 represent some more special embodiments which show that the segments, and in particular partition walls 35 formed thereof, may consist of elements, in particular plates or the like, which may have a varying thickness and/or a shape which deviates from a flat shape, as a function of the desired effect.

Figure 21 shows another embodiment with a partition wall 51 which is made as a cross partition, and in particular as a blade-shaped guide near the outlet opening or outlet openings 18. In principle, the partition wall 51 can be made as a loose segment provided between neighbouring segments, but it is easier to make use of a segment 52 as represented in figure 22.

It is clear that it is also possible to realise embodiments by means of the above-mentioned segments having longitudinal as well as cross partition in the flow-through canalisation 17, for example by placing several segments 52 against one another. Thus, it is possible to realise a nozzle 3 with a whole series of outlet openings 18, whereby separate ducts to each outlet opening 18 are at least formed in the head of the nozzle 3.

In the given examples, the flow-through canalisation 17 generally extends in the longitudinal direction of the nozzle 3 and it traces a curve near the top end to finally flow into the outlet opening or outlet openings 18. The above-mentioned partition walls 35 and 51 hereby preferably extend through at least a part of this curve. This offers the advantage that the fluid is easily bent with a minimal

risk of unwanted turbulences being created which might have a negative influence on the fluid jet 8.

Figures 23 to 28 represent a special embodiment with a nozzle 3 having a series of outlet openings 18 which are arranged in a stepped manner, thanks to the construction in segments, as of one far end of the series to its other far end, which results in the advantages mentioned in the introduction.

The direction of the stepped shape is preferably selected such that a bundle of parallel or almost parallel outgoing fluid jets, in particular partial jets 8A is obtained, whereby the intersections of these partial jets 8A with a theoretical plane 53 going through the guiding duct 6 and standing at right angles to the surface of the reed 5, are all situated at practically the same distance from the outlet openings 18, which amounts to some 50 mm.

The nozzle 3 with the step-like arranged outlet openings 18 is particularly suitable to be made with a lateral protuberance corresponding to the invention which is described in Belgian patent No. 1,012,608.

It should be noted that the different parts of the segments can be held together in the right position in any way whatsoever while being joined, until they are fixed to each other. Figure 29 represents a practical possibility for holding two parts 19A and 19B of a segment 19 in a fixed position until this segment 19 is connected to other segments. To this end, an additive 54 is formed for the

outlet opening 18 to be formed which connects the parts 19A and 19B to each other, which additive 54 is removed after the segments have been joined and fixed to each other, for example up to the indicated line 55, by means of milling, grinding or the like.

In this manner can also be provided a blade in a simple manner in a nozzle formed of segments, by making use of an additive 54 as represented in figure 30.

All the embodiments described above by means of the figures are applications of the aforesaid first aspect of the invention. It is clear that, in a number of these embodiments, also one or several of the other aspects mentioned in the introduction have been applied. As explained in the introduction, however, the characteristics according to the second to eighth aspect can also be realised independently of the first aspect, as well as independently of each other, without making use of a segmented construction.

In the case of a segmented construction, however, it is possible to work with mainly horizontal segments, by which are meant segments extending mainly perpendicular to the longitudinal direction of the nozzle.

The invention is by no means limited to the above-described embodiments given as an example and represented in the accompanying drawings; on the contrary, such a nozzle can be made in many sorts of shapes and dimensions while still remaining within the scope of the invention.